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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/943,782	Applicant(s) SPITSBERG ET AL.	
	Examiner Wesley D Markham	Art Unit 1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 January 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3 and 5-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3 and 5-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 January 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

1. Acknowledgement is made of the applicant's amendment filed on 1/20/2004 (with a certificate of mailing dated 1/15/2004), in which a new title of the invention was submitted, the specification was amended, 2 sheets of formal drawings were submitted, Claim 1 was amended, Claim 4 was canceled, and Claims 20 – 23 were added. **Claims 1 – 3 and 5 – 23** are currently pending in U.S. Application Serial No. 09/943,782, and an Office Action on the merits follows.

Drawings

2. The formal drawings (2 sheets, 3 figures) filed on 1/20/2004 are approved by the examiner. As such, the objection to the drawings set forth in paragraph 3 of the previous Office Action (i.e., the non-final Office Action, mailed on 10/16/2003) is withdrawn.

Specification

3. The objections to the specification, set forth in paragraphs 4 and 5 of the previous Office Action, are withdrawn in light of the applicant's amendment in which a descriptive title of the invention was submitted and the appropriate trademarks were capitalized.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Newly added **Claim 23** is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, Claim 23 recites, in part, "The method of Claim 23, wherein the step..." As such, Claim 23 depends from itself, thereby rendering the scope of Claim 23 unclear (i.e., because it is unclear what limitations are required by Claim 23 other than those explicitly recited in the claim). For the purposes of examination only, the examiner has interpreted Claim 23 to depend from Claim 22.

Claim Observations

6. Regarding newly added **Claim 21**, the claim recites, in part, "The method of Claim 16, wherein the step of producing includes..." Although Claim 16 does not explicitly recite a step of "producing", it would be clear to one skilled in the art that "the step of producing" recited in Claim 21 refers to the step of "controllably oxidizing the bond coat surface" in Claim 16, and Claim 21 has been interpreted by the examiner as such.

7. Please note that the rejection of Claims 1 – 3, 12, 14, and 15 under 35 U.S.C. 103(a) as being unpatentable over Beele (USPN 6,127,048) in view of Bruce et al. (USPN 5,981,088), set forth in paragraphs 23 – 24 of the previous Office Action, is withdrawn in light of the applicant's amendment in which independent Claim 1 was amended to require that the bond coat be a diffusion aluminide bond coat. This limitation is not reasonably suggested by the combination of Beele and Bruce et al.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

9. Claims 1 – 3, 5, 9, 10, 14, 15, 20, 22, and 23 are rejected under 35 U.S.C. 102(a) as being anticipated by Schaeffer et al. (USPN 6,123,997).
10. Regarding independent **Claims 1 and 22**, Schaeffer et al. teaches a method of fabricating an article protected by a thermal barrier coating (TBC) system (Abstract), the method comprising the steps of providing an article substrate having a substrate surface (Figure 2, reference number "22", Col.3, lines 6 – 12, and Col.4, lines 19 – 54), thereafter producing a pre-oxidized bond coat on the substrate surface, the step of producing the pre-oxidized bond coat including the steps of (1) depositing a bond coat, specifically a diffusion aluminide bond coat (Col.3, lines 28 – 32), on the substrate surface, the bond coat having a bond coat surface (Figure 2, reference

number "24", and Col.3, lines 14 – 50), and (2) controllably oxidizing the bond coat surface to form a pre-oxidized bond coat surface (Figure 2, reference number "28", Col.3, line 15, Col.4, lines 55 – 67, and Col.5, lines 1 – 48), and thereafter depositing a TBC overlying the pre-oxidized bond coat surface, the TBC comprising yttria-stabilized zirconia (YSZ) having a yttria content of from about 3 percent by weight to about 5 percent by weight of the YSZ (Figure 2, reference number "26", Col.3, lines 14 – 17 and 51 – 67 (especially lines 53 – 56), Col.4, lines 1 – 19, and Col.5, lines 12 – 15).

11. Schaeffer et al. also teaches all the limitations of **Claims 2, 3, 5, 9, 10, 14, 15, 20, and 23** as set forth above in paragraph 10 and below, including a method wherein / further comprising:

- Claim 2: The article substrate comprises a nickel-base superalloy (Col.3, lines 9 – 10, and Col.4, lines 19 – 54).
- Claim 3: The article substrate comprises a component of a gas turbine engine (Col.1, lines 24 – 65, Col.3, lines 6 – 8, and Col.4, lines 18 – 19).
- Claim 5: The step of depositing the bond coat includes the step of depositing a platinum aluminide bond coat (Col.3, lines 28 – 32).
- Claim 9: The step of controllably oxidizing the bond coat includes heating the bond coat to an oxidizing temperature of from about 1800° F to about 2100° F (Col.5, lines 16 – 21).

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- Claim 10: The step of controllably oxidizing the bond coat includes heating the bond coat to an oxidizing temperature for a time of from about ½ hour to about 3 hours (Col.5, lines 16 – 21).
- Claim 14: The TBC is deposited by physical vapor deposition (PVD) (Col.4, lines 1 – 2).
- Claim 15: The TBC has a yttria content from about 3.8 to about 4.2 percent by weight of the YSZ (Col.3, lines 53 – 56).
- Claims 20 and 23: The pre-oxidized bond coat has a layer of Al₂O₃ (i.e., alumina) thereon (Abstract, Col.4, lines 55 – 67, and Col.5, lines 1 – 48).

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

13. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order

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for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

14. Claims 6 – 8, 11 – 13, 16 – 19, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schaeffer et al. (USPN 6,123,997).

15. Schaeffer et al. explicitly teaches all the limitations of **Claims 6 – 8 and 11** as set forth above in paragraphs 10 and 11, except for a method wherein the step of controllably oxidizing the bond coat includes the step of heating the bond coat in an atmosphere having a partial pressure of oxygen of from about 10^{-5} mbar to about 10^3 mbar (Claim 6), specifically about 10^{-5} mbar to about 10^{-2} mbar (Claim 7), more specifically about 10^{-4} mbar (Claims 8 and 11). Please note that, regarding Claim 11, Schaeffer et al. does teach heating the bond coat to a temperature of from about 2000° F to about 2100° F for a time of from about $\frac{1}{2}$ hour to about 3 hours (Col.5, lines 12 – 21). Additionally, Schaeffer et al. does teach heating and controllably oxidizing the bond coat in an “oxygen-rich environment”, which Schaeffer et al. defines as an atmosphere having an oxygen partial pressure greater than 10^{-33} atm (i.e., greater than about 10^{-30} mbar) (Col.5, lines 12 – 33). The oxygen partial pressure range taught by Schaeffer et al. encompasses the applicant’s claimed pressure range(s) / value(s). Since Schaeffer et al. teaches controllably oxidizing the bond coat in an atmosphere having an oxygen partial pressure greater than 10^{-33} atm (i.e., greater than about 10^{-30} mbar), it would have been obvious to one of ordinary skill in the art to utilize any oxygen partial pressure value, including values

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claimed by the applicant (e.g., about 10^{-4} mbar) or within the applicant's claimed ranges, within the range disclosed by Schaeffer et al. with the reasonable expectation of successfully and advantageously oxidizing the bond coat in an "oxygen-rich environment", as desired by Schaeffer et al. One of ordinary skill in the art would have reasonably expected that utilizing relatively high oxygen partial pressure values would lead to faster oxidation than utilizing relatively low oxygen partial pressure values and would have chosen the oxidation conditions accordingly, so long as an "oxygen-rich environment" is utilized, as desired by Schaeffer et al. Please note that a prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a *prima facie* case of obviousness (*In re Peterson*, 315 F.3d 1325, 1130, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003)).

16. Schaeffer et al. teaches all the limitations of **Claims 12 and 13** as set forth above in paragraphs 10 – 11, except for a method wherein the steps of depositing the bond coat and controllably oxidizing the bond coat are performed concurrently (Claim 12), or the step of controllably oxidizing the bond coat is performed after the step of depositing the bond coat (Claim 13). However, Schaeffer et al. does teach that the alumina scale (i.e., the layer produced by the oxidation of the bond coat) is formed "in situ", and the oxidation of the bond coat occurs before the deposition of the TBC (Col.3, lines 14 – 16, and Col.5, lines 12 – 15). Schaeffer et al. is silent regarding the specific time period before the deposition of the TBC that the bond coat is oxidized. However, under these circumstances taught by Schaeffer et al. (i.e., that the

oxidation of the bond coat occurs before the deposition of the TBC), there are only two possible time periods during which the bond coat could be oxidized – (1) during the deposition of the bond coat and before the deposition of the TBC, and (2) after the deposition of the bond coat and before the deposition of the TBC. Since the bond coat must be oxidized during at least one of these time periods in order to achieve the pre-oxidized bond coat desired by Schaeffer et al., it would have been obvious to one of ordinary skill in the art to oxidize the bond coat either concurrently with or after the deposition of the bond coat with the reasonable expectation of success and obtaining similar results (i.e., successfully oxidizing the bond coat to form an adherent alumina scale, regardless of whether the oxidation is done after the deposition or concurrently with the deposition). Both alternatives would be expected by one of ordinary skill in the art to have different advantages. For example, by performing the deposition and oxidation concurrently, a separate oxidation step would not be required, thereby advantageously reducing processing time; however, by performing the oxidation as a separate step after the deposition, there would be less process variables to simultaneously regulate, thereby advantageously allowing the oxidation process to be more exactly and precisely controlled.

17. Regarding independent **Claim 16**, this claim mirrors independent Claim 1 (which has been discussed at length in paragraph 10 above) and additionally requires that (1) the substrate be a nickel-base superalloy, (2) the substrate comprise a component of a gas turbine engine, (3) the bond coat be platinum aluminide, and (4) the

oxidation step be performed after the bond coat deposition step. These limitations are also taught / reasonably suggested by Schaeffer et al. (see the discussion of Claims 2, 3, 5, and 13 in paragraphs 11 and 16 above). Regarding **Claim 17**, Schaeffer et al. does not explicitly teach that the step of controllably oxidizing the bond coat includes the step of heating the bond coat in an atmosphere having a partial pressure of oxygen of from about 10^{-5} mbar to about 10^3 mbar. However, this limitation would have been obvious to one of ordinary skill in the art for the reasons set forth above in paragraph 15. Regarding **Claim 18**, Schaeffer et al. teaches that the step of controllably oxidizing the bond coat includes heating the bond coat to an oxidizing temperature of from about 1800° F to about 2100° F (Col.5, lines 16 – 21). Regarding **Claim 19**, Schaeffer et al. teaches that the TBC has a yttria content from about 3.8 to about 4.2 percent by weight of the YSZ (Col.3, lines 53 – 56). Regarding **Claim 21**, Schaeffer et al. teaches that the pre-oxidized bond coat surface has a layer of Al_2O_3 (i.e., alumina) thereon (Abstract, Col.4, lines 55 – 67, and Col.5, lines 1 – 48).

18. Claims 1 – 3, 5 – 9, and 13 – 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Duderstadt et al. (USPN 5,238,752) in view of Bruce et al. (USPN 5,981,088).
19. Regarding independent **Claims 1, 16, and 22**, Duderstadt et al. teaches a method of fabricating an article protected by a TBC system (Abstract), the method comprising the steps of providing an article substrate, specifically a nickel-base superalloy

article substrate comprising a component of a gas turbine engine, having a substrate surface (Figure 1, Figure 2, reference number "22", Col.1, lines 6 – 32, Col.2, lines 32 – 36, Col.4, lines 39 – 60, and Col.8, lines 28 – 46), thereafter producing a pre-oxidized bond coat on the substrate surface, the step of producing the pre-oxidized bond coat including the steps of (1) depositing a bond coat, specifically a platinum diffusion aluminide bond coat, on the substrate surface, the bond coat having a bond coat surface (Figures 2 and 3, reference number "24", Col.2, lines 45 – 53 and 68, Col.3, lines 1 – 3 and 24 – 28, Col.5, lines 35 – 68, and Col.6, lines 1 – 44), and (2) thereafter, controllably oxidizing the bond coat surface to form a pre-oxidized bond coat surface (Figures 2 and 3, reference number "28", Col.2, lines 53 – 55, Col.3, lines 45 – 61, Col.6, lines 45 – 59, and Col.7, lines 27 – 38), and thereafter, depositing a TBC overlying the pre-oxidized bond coat surface, the TBC comprising YSZ (Figures 2 and 3, reference number "30", Col.2, lines 57 – 62, Col.3, lines 59 – 67, Col.4, lines 1 – 6, Col.7, and Col.8, lines 1 – 17). Duderstadt et al. does not explicitly teach that the YSZ has a yttria content of from about 3% by weight to about 5% by weight of the YSZ. Specifically, the yttria content in the YSZ taught by Duderstadt et al. is about 6 to 20% by weight (Abstract, Col.2, lines 56 – 60, and Col.7, lines 1 – 10). Bruce et al. teaches a TBC system to be utilized as a protective coating on gas turbine engine components (Abstract). The ceramic TBC layer is formed of YSZ having a columnar grain structure, the YSZ preferably containing about 2 to 5% by weight of yttria (Abstract). Importantly, Bruce et al. also teaches that, by using YSZ having a yttria content of less than 6% by weight, specifically

about 2 to 5% by weight, the TBC system exhibits superior spallation resistance and adhesion when compared to conventional YSZ TBCs, such as 7%YSZ (Col.1, lines 5 – 11 and 63 – 66, Col.2, lines 39 – 50, Col.3, lines 37 – 50, and Col.4, lines 1 – 33 and 46 – 53). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a YSZ TBC having a yttria content of about 2 to 5% by weight (i.e., a weight percent within the applicant's claimed range), as taught by Bruce et al., in the process of Duderstadt et al. as opposed to a YSZ TBC having a higher yttria content, such as about 6 to 20% by weight (as taught by Duderstadt et al.), with the reasonable expectation of successfully and advantageously producing a TBC on a gas turbine engine component that exhibits superior adhesion and spallation resistance, thereby increasing the life of the component.

20. The combination of Duderstadt et al. and Bruce et al. also teaches all the limitations of **Claims 2, 3, 5 – 9, 13 – 15, 17 – 21, and 23** as set forth above in paragraph 19 and below, including a method wherein / further comprising:

- Claims 2 and 3: The article substrate comprises a nickel-base superalloy (Claim 2) and a component of a gas turbine engine (Claim 3) (Figure 1, Figure 2, reference number "22", Col.1, lines 6 – 32, Col.2, lines 32 – 36, Col.4, lines 39 – 60, and Col.8, lines 28 – 46 of Duderstadt et al.).
- Claim 5: The step of depositing the bond coat includes the step of depositing a platinum aluminide bond coat (Col.3, lines 10 – 44, Col.5, lines 36 – 68, and Col.6, lines 1 – 22 of Duderstadt et al., and Col.1, lines 26 – 32 of Bruce et al.).

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- Claims 6 – 8 and 17: The step of controllably oxidizing the bond coat includes the step of heating the bond coat in an atmosphere having a partial pressure of oxygen of from about 10^{-5} mbar to about 10^3 mbar (Claims 6 and 17), specifically about 10^{-5} mbar to about 10^{-2} mbar (Claim 7), more specifically about 10^{-4} mbar (Claim 8). Specifically, Duderstadt et al. teaches that the preferred oxidizing atmosphere in which to heat the bond coat is air at a pressure of 5×10^{-5} Torr (Col.7, lines 30 – 38). An air pressure of 5×10^{-5} Torr is equivalent to an air pressure of about 6.6×10^{-5} mbar. Since air is approximately 21% oxygen, the partial pressure of oxygen in the oxidizing atmosphere of Duderstadt et al. is equal to: $(0.21)(6.6 \times 10^{-5}) = \text{about } 1.38 \times 10^{-5}$ mbar. This value is within the range claimed by the applicant in Claims 6, 7, and 17. Further, the examiner has reasonably interpreted an oxygen partial pressure of about 1.38×10^{-5} mbar, as taught by Duderstadt et al., to be “about 10^{-4} mbar”, as required by applicant’s Claim 8. In the alternative (i.e., if the applicant intends to exclude a value of about 1.38×10^{-5} mbar by reciting “about 10^{-4} mbar”), it is the examiner’s position that it would have been obvious to one of ordinary skill in the art to slightly increase the oxygen partial pressure (i.e., concentration) in the oxidation process of Duderstadt et al. (e.g., to about 10^{-4} mbar) with the reasonable expectation of successfully and advantageously increasing the speed at which the oxidation process is performed, thereby reducing processing time. Please note that, generally, differences in concentration will not support the patentability of subject matter

encompassed by the prior art unless there is evidence indicating that such concentration is critical (MPEP 2144.05(II)(A)).

- Claims 9 and 18: The step of controllably oxidizing the bond coat includes heating the bond coat to an oxidizing temperature of from about 1800° F to about 2100° F (Col.7, line 35 of Duderstadt et al.).
- Claim 13: The step of controllably oxidizing the bond coat is performed after the step of depositing the bond coat (Col.3, lines 45 – 51 of Duderstadt et al.).
- Claim 14: The TBC is deposited by PVD (Col.3, lines 62 – 68, and Col.7, lines 13 – 15 of Duderstadt et al., and Abstract of Bruce et al.).
- Claims 15 and 19: The TBC has a yttria content from about 3.8 to about 4.2 percent by weight of the YSZ (Col.4, lines 15 – 60 of Bruce et al.).
- Claims 20, 21, and 23: The pre-oxidized bond coat has a layer of Al₂O₃ (i.e., alumina, or aluminum oxide) thereon (Abstract, Col.3, lines 45 – 61, and Col.6, lines 45 – 61).

21. Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Duderstadt et al. (USPN 5,238,752) in view of Bruce et al. (USPN 5,981,088), and in further view of Schaeffer et al.(2) (USPN 5,780,110).

22. The combination of Duderstadt et al. and Bruce et al. teaches all the limitations of **Claims 10 and 11** as set forth above in paragraphs 19 and 20, except for a method wherein the step of controllably oxidizing the bond coat includes the step of heating the bond coat to an oxidizing temperature for a time of from about ½ hour to about 3

hours (Claims 10 and 11) and to a temperature of from about 2000° F to about 2100° F (Claim 11). Please note that Duderstadt et al. does teach / reasonably suggest heating the bond coat in an atmosphere having a partial pressure of oxygen of about 10^{-4} mbar, as required by Claim 11 (see the discussion of Claim 8 in paragraph 20 above). Additionally, Duderstadt et al. teaches that the oxidation can be accomplished by heating the bond coat for a period of up to about 10 minutes at a temperature of about 1800° F (Col.7, lines 27 – 38). Duderstadt et al. teaches that this heating temperature and time is sufficient to oxidize the bond coat to a thickness of about 2×10^{-5} inches, which is the most preferred thickness (Col.7, lines 35 – 38). However, Duderstadt et al. also teaches that the layer of aluminum oxide (i.e., the oxidized bond coat) can be much thicker, such as 1.2×10^{-4} inches thick (i.e., almost ten times as thick as the most preferred thickness) (Col.2, lines 53 – 56). Schaeffer et al.(2) teaches that, in the art of pre-oxidizing a bond coat prior to the deposition of a TBC (i.e., a process analogous to that of Duderstadt et al.), the pre-oxidation should occur at temperatures above 1000° C (1832° F) and for times greater than 1 hour in oxygen rich environments (Col.4, lines 47 – 57). The temperature range taught by Schaeffer et al.(2) encompasses the applicant's claimed range, and the oxidation time taught by Schaeffer et al.(2) is squarely within the applicant's claimed range. Additionally, the oxidation temperature and time taught by Schaeffer et al.(2) are higher and longer, respectively, than the oxidation temperature and time taught by Duderstadt et al. It would have been obvious to one of ordinary skill in the art to utilize the bond coat oxidation temperature and time taught by Schaeffer et al.(2)

(and claimed by the applicant) in the process of Duderstadt et al. with the reasonable expectation of successfully and advantageously oxidizing the bond coat to form an alumina scale having a thickness desired by Duderstadt et al. (e.g., a thickness such as 1.2×10^{-4} inches – much thicker than the 2×10^{-5} inches thick oxidation layer taught by Duderstadt et al. to be formed at a temperature of 1800° F) and a time of up to 10 minutes). One of ordinary skill in the art would have used the higher oxidation temperature and longer oxidation time taught by Schaeffer et al.(2) in the situation wherein the oxidized bond coat is desired to be thicker than that produced by the oxidation conditions explicitly disclosed by Duderstadt et al.

23. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Duderstadt et al. (USPN 5,238,752) in view of Bruce et al. (USPN 5,981,088), and in further view of Strangman (USPN 5,514,482).

24. The combination of Duderstadt et al. and Bruce et al. teaches all the limitations of **Claim 12** as set forth above in paragraph 19, except for a method wherein the steps of depositing the bond coat and controllably oxidizing the bond coat are performed concurrently. Specifically, Duderstadt et al. teaches that the bond coat is oxidized after it is deposited. However, Strangman teaches that, in the art of oxidizing an aluminide bond coat in a TBC system to form alumina scale (i.e., a process analogous to that of Duderstadt et al.), the alumina scale may generally be formed before the ceramic TBC is applied (Col.4, lines 3 – 31). The exact time period during which the alumina scale is formed on the bond coat does not appear to be limited in

the process of Strangman et al. However, under the circumstances taught by Strangman (i.e., that the alumina scale is formed on the bond coat before the deposition of the TBC), there are only two possible time periods during which the bond coat could be oxidized – (1) during the deposition of the bond coat and before the deposition of the TBC, and (2) after the deposition of the bond coat and before the deposition of the TBC. Since the bond coat must be oxidized during at least one of these time periods in order to achieve the pre-oxidized bond coat desired by Duderstadt et al., it would have been obvious to one of ordinary skill in the art to oxidize the bond coat either concurrently with or after the deposition of the bond coat with the reasonable expectation of success and obtaining similar results (i.e., successfully oxidizing the bond coat to form an adherent alumina scale, regardless of whether the oxidation is done after the deposition or concurrently with the deposition). Both alternatives would be expected by one of ordinary skill in the art to have different advantages. For example, by performing the deposition and oxidation concurrently, a separate oxidation step would not be required, thereby advantageously reducing processing time; however, by performing the oxidation as a separate step after the deposition, there would be less process variables to simultaneously regulate, thereby advantageously allowing the oxidation process to be more exactly and precisely controlled

25. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Beele (USPN 6,127,048) in view of Bruce et al. (USPN 5,981,088).

26. Regarding independent **Claim 22**, Beele teaches a method of fabricating an article protected by a TBC system (Abstract and Col.1, lines 16 – 22), the method comprising the steps of providing an article substrate having a substrate surface (Figure 1, reference number “1”, Col.1, lines 16 – 17, and Col.6, lines 4 – 18), thereafter, producing a pre-oxidized bond coat on the substrate surface, the step of producing the pre-oxidized bond coat including the steps of depositing a bond coat on the substrate surface, the bond coat having a bond coat surface, and controllably oxidizing the bond coat surface to form a pre-oxidized bond coat surface, wherein the steps of depositing the bond coat and oxidizing the bond coat are performed concurrently (Figure 1, reference number “3”, Col.4, lines 60 – 67, Col.5, lines 13 – 26, Col.6, lines 25 – 26, 35 – 40, and 54 – 67, and Col.7, lines 1 – 15), and thereafter, depositing a TBC overlying the pre-oxidized bond coat surface, the TBC comprising a “partly stabilized zirconia” (Figure 1, reference number “2”, Col.3, lines 52 – 56, Col.5, lines 27 – 31, Col.6, lines 19 – 24, and Col.7, lines 16 – 20). Please note that the examiner has interpreted the first oxide anchoring layer “3” of Beele to be the “bond coat” of the applicant’s claims, and the second oxide layer “2” of Beele to be the “thermal barrier coating overlying the pre-oxidized bond coat surface” of the applicant’s claims. Beele does not explicitly teach that the TBC is YSZ having a yttria content of from about 3% by weight to about 5% by weight of the YSZ. However, Beele does teach that the oxide layer “2” (i.e., the TBC) should be made of a columnar grained oxide ceramic such as partially stabilized zirconia and can be deposited by PVD (Col.6, lines 19 – 24, and Col.7, lines 16 – 20). Bruce et al.

teaches a TBC system to be utilized as a protective coating on gas turbine engine components (Abstract). The ceramic TBC layer is formed of YSZ having a columnar grain structure, the YSZ preferably containing about 2 to 5% by weight of yttria (Abstract). Importantly, Bruce et al. also teaches that, by using YSZ having a yttria content of less than 6% by weight, specifically about 2 to 5% by weight, the TBC system exhibits superior spallation resistance and adhesion when compared to conventional YSZ TBCs, such as 7%YSZ (Col.1, lines 5 – 11 and 63 – 66, Col.2, lines 39 – 50, Col.3, lines 37 – 50, and Col.4, lines 1 – 33 and 46 – 53). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a YSZ TBC having a yttria content of about 2 to 5% by weight (i.e., a weight percent within the applicant's claimed range), as taught by Bruce et al., as the "partially stabilized zirconia" layer "2" in the process of Beele with the reasonable expectation of successfully and advantageously producing a TBC that exhibits superior adhesion and spallation resistance, thereby increasing the life of the coating / component.

Double Patenting

27. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214

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USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969). A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b). Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

28. Claims 1 – 11 and 13 – 23 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1 – 16 of U.S. Patent No. 6,576,067 B2 in view of Bruce et al. (USPN 5,981,088).
29. Specifically, Claims 1 – 16 of U.S. Patent No. 6,576,067 B2 teach all the limitations of **Claims 1 – 11 and 13 – 23** of the instant application, as well as teaching additional process steps such as polishing and controllably roughening the bond coat surface, except the limitation that the TBC overlying the pre-oxidized bond coat surface comprises YSZ having a yttria content of from about 3 percent by weight to about less than 6 percent by weight of the YSZ, particularly from about 3.8 to about 4.2 percent by weight. Specifically, Claims 1 – 16 of U.S. Patent No. 6,576,067 B2 are silent as to the nature of the TBC (see Claims 9 and 15 of U.S. Patent No. 6,576,067 B2). However, depositing a YSZ TBC having a yttria content in the range claimed by the applicant would have been obvious to one of ordinary skill in the art

in light of the teachings of Bruce et al. for the reasons set forth in paragraph 19 above (i.e., producing a TBC system on a gas turbine engine component that exhibits superior adhesion and spallation resistance, thereby increasing the life of the component). Regarding Claims 20, 21, and 23, Claims 1 – 16 of U.S. Patent No. 6,576,067 B2 do not explicitly teach that the pre-oxidized bond coat has a layer of Al_2O_3 (i.e., alumina, or aluminum oxide) thereon. However, the diffusion / platinum aluminide bond coats that are controllably pre-oxidized in Claims 1 – 16 of U.S. Patent No. 6,576,067 B2 would have inherently had a layer of Al_2O_3 thereon because such bond coats, when oxidized, necessarily form Al_2O_3 (alumina) (See, for example, Schaeffer et al. and Duderstadt et al., as fully discussed in the paragraphs above).

30. Claims 1 – 11 and 13 – 23 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1 – 22 of U.S. Patent No. 6,565,672 B2 in view of Bruce et al. (USPN 5,981,088).

31. Specifically, Claims 1 – 22 of U.S. Patent No. 6,565,672 B2 teach all the limitations of **Claims 1 – 11 and 13 – 23** of the instant application, as well as teaching additional process steps such as flattening the bond coat surface, except the limitation that the TBC overlying the pre-oxidized bond coat surface comprises YSZ having a yttria content of from about 3 percent by weight to about 5 percent by weight of the YSZ, particularly from about 3.8 to about 4.2 percent by weight. Specifically, Claims 1 – 22 of U.S. Patent No. 6,565,672 B2 are silent as to the

nature of the TBC (see Claim 22 of U.S. Patent No. 6,565,672 B2). However, depositing a YSZ TBC having a yttria content in the range claimed by the applicant would have been obvious to one of ordinary skill in the art in light of the teachings of Bruce et al. for the reasons set forth in paragraph 19 above (i.e., producing a TBC system on a gas turbine engine component that exhibits superior adhesion and spallation resistance, thereby increasing the life of the component). Regarding Claims 20, 21, and 23, Claims 1 – 22 of U.S. Patent No. 6,565,672 B2 do not explicitly teach that the pre-oxidized bond coat has a layer of Al_2O_3 (i.e., alumina, or aluminum oxide) thereon. However, the diffusion / platinum aluminide bond coats that are controllably pre-oxidized in Claims 1 – 22 of U.S. Patent No. 6,565,672 B2 would have inherently had a layer of Al_2O_3 thereon because such bond coats, when oxidized, necessarily form Al_2O_3 (alumina) (See, for example, Schaeffer et al. and Duderstadt et al., as fully discussed in the paragraphs above).

Response to Arguments

32. Applicant's arguments filed on 1/20/2004 have been fully considered but they are not persuasive.
33. Regarding the 35 U.S.C. 102 rejection based on Schaeffer et al., the applicant argues that Schaeffer et al. does not disclose a TBC comprising YSZ having a yttria content of from about 3 percent by weight to about 5 percent by weight of the YSZ. In response, the examiner disagrees with this assertion. Schaeffer et al. teaches YSZ having a yttria content of, for example, 4 to 20 wt% (Col.3, lines 53 – 56). The

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endpoint of this range taught by Schaeffer et al. is 4 wt%, which is a value squarely within the applicant's claimed range. Please note that a specific example in the prior art which is within a claimed range anticipates the range (MPEP 2131.03).

Additionally, the range of Schaeffer et al., at the very least, overlaps the applicant's claimed range. Prior art which teaches a range overlapping the claimed range anticipates if the prior art range discloses the claimed range with sufficient specificity (MPEP 2131.03). In this case, the endpoint of the prior art range taught by Schaeffer et al. falls squarely in the middle of the applicant's claimed range, and half of the applicant's entire claimed range is encompassed by the range taught by Schaeffer et al. As such, the range of Schaeffer et al. discloses the claimed range with "sufficient specificity", thereby anticipating the claimed range.

34. Regarding the 35 U.S.C. 103(a) rejections based on Schaeffer et al., the applicant attempts to rebut the *prima facie* case of obviousness by showing criticality of the claimed oxygen partial pressure range. In the attempt to show criticality, the applicant cites paragraphs [0024] and [0025] of the specification of the instant application. After reviewing the cited portions of the specification and the specification as a whole, the examiner disagrees with the applicant's assertion that the claimed range is "critical" or leads to "unexpected experimental results", especially when taken in view of the disclosure of Schaeffer et al. For example, paragraphs [0025] states, in part, that if the pre-oxidation parameters lie outside the appropriate ranges, an alumina scale will be produced, but it will be less desirable than the alumina scale produced by pre-oxidation within the ranges. The fact that a

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certain portion of the range leads to more desirable results and another portion of the range leads to less desirable results is not sufficient to establish unexpected results or that the range is critical. Additionally, the applicant's statement in paragraph [0025] of the specification that, "Non-uniform microstructures resulted when the pre-oxidation pressure was greater than about 10^{-4} mbar" contradicts the applicant's assertion of the criticality of the claimed range, which is, "from about 10^{-5} mbar to about 10^3 mbar". From this statement, it is seen that the majority of the claimed range of pre-oxidation pressures falls within a range that is disclosed by the applicant to lead to non-uniform microstructures. This is clear evidence that the claimed range is not "critical" and does not provide "unexpected results". Additionally and importantly, the allegedly "critical" pre-oxidation parameters of the applicant are selected so as to achieve a desired alpha alumina microstructure (see paragraph [0025]). However, Schaeffer et al. also goes to great lengths to insure that the alumina formed on the bond coat by the pre-oxidation process is mature alpha alumina without other undesirable crystal structures (Col.4, lines 55 – 67, and Col.5, lines 1 – 48). As such, the beneficial results obtained by the applicant (i.e., obtaining a desired alpha alumina microstructure) due to the use of specific oxidation conditions (e.g., partial pressure) are also obtained by Schaeffer et al.'s pre-oxidation of the bond coat under "specified conditions" (Col.5, lines 4 – 8).

35. The applicant also argues that Schaeffer teaches a range of yttria of 4 – 20 percent, and then preferred ranges of 6 – 20 percent and 6 – 10 percent, which preferred ranges teach away from the present approach. This argument is not persuasive

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because, regardless of the preferred embodiments of Schaeffer et al., Schaeffer et al. also teaches a range (i.e., 4 – 20 percent) that has an endpoint within the applicant's claimed range, thereby anticipating such range. Please note that the teachings of a reference are not limited to its preferred embodiments.

36. Regarding Claims 12 – 13, the applicant argues that Schaeffer has no teaching of the temporal relation of the (bond coat) deposition and oxidation steps. In response, the examiner agrees that Schaeffer et al. does not explicitly teach the temporal relation of the deposition and oxidation steps. As such, Claims 12 – 13 were not rejected under 35 U.S.C. 102. However, the examiner maintains that the subject matter of Claims 12 – 13 would have been obvious to one of ordinary skill in the art (see the discussion in paragraph 16 above for details).

37. Regarding the 35 U.S.C. 103 rejection based on Duderstadt and Bruce, the applicant first argues that Duderstadt et al. explicitly teaches away from the claimed range. However, the applicant does not point to or show how or why Duderstadt et al. teaches away from the claimed range. The examiner can only assume that the applicant is relying on the teaching in Duderstadt et al. that the ceramic topcoat is preferably zirconium oxide having from about 6 to 20 percent yttrium oxide (i.e., a value outside the claimed range). This is far from “teaching away” from the claimed range. Again, the examiner notes that the teachings of a reference are not limited to its preferred embodiments. Duderstadt et al. more broadly teaches that the preferred ceramic topcoat is zirconium oxide, either without modification or with a small amount of a modifier added (Col.7, lines 1 – 7). This teaching clearly encompasses

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the applicant's claimed TBC and does not "teach away" from the claimed limitation.

The applicant then argues that the combination of references relied upon by the examiner is purely a hindsight reconstruction of the present claims and there is no objective basis for combining the teachings of the references in the manner used by the examiner. In response, the examiner strongly disagrees. Please note that it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). Additionally, Bruce et al. provides clear, unmistakable, and explicit motivation to combine the teachings of the references in the manner done so by the examiner. In detail, Bruce et al. teaches a TBC system to be utilized as a protective coating on gas turbine engine components (Abstract). The ceramic TBC layer is formed of YSZ having a columnar grain structure, the YSZ preferably containing about 2 to 5% by weight of yttria (Abstract). Importantly, Bruce et al. also teaches that, by using YSZ having a yttria content of less than 6% by weight, specifically about 2 to 5% by weight, the TBC system exhibits superior spallation resistance and adhesion when compared to conventional YSZ TBCs, such as 7%YSZ (Col.1, lines 5 – 11 and 63 – 66, Col.2, lines 39 – 50, Col.3, lines 37 – 50, and Col.4, lines 1 – 33 and 46 – 53). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a YSZ TBC having a yttria content of about 2 to

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5% by weight (i.e., a weight percent within the applicant's claimed range), as taught by Bruce et al., in the process of Duderstadt et al. as opposed to a YSZ TBC having a higher yttria content, such as about 6 to 20% by weight (as taught by Duderstadt et al.), with the reasonable expectation of successfully and advantageously producing a TBC on a gas turbine engine component that exhibits superior adhesion and spallation resistance, thereby increasing the life of the component.

38. Regarding Claims 10 – 11, the applicant argues that Duderstadt teaches away from the heating time period limitation (i.e., about ½ hour to about 3 hours) by teaching heating for a period of up to about 10 minutes. In response, a different teaching or teaching a different way is not equivalent to “teaching away” from a claimed limitation. Additionally, the applicant's argument that one would go to higher temperatures to produce a thicker oxide layer so that a longer time would not be necessary is unconvincing. It is the examiner's position that one of ordinary skill in the art would be reasonably expected to perform the oxidation at higher temperatures, for longer times, or both in order to achieve a desired thicker oxide layer. The exact temperature and time would, of course, be dependent on the thickness of the oxide layer desired by the purveyor in the art.

39. Regarding the 35 U.S.C. 103 rejection based on Beele and Bruce, the applicant states that Beele teaches that the zirconia must be deposited on an anchoring layer that is a ternary oxide, and Bruce teaches that the YSZ must be deposited on an Al₂O₃ scale, which is a binary oxide. In response, the examiner has reviewed the cited portions of the Beele and Bruce documents, as well as the documents as a

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whole, and notes that no such teachings are present. Therefore, the applicant's argument is unconvincing. Briefly, Beele does not explicitly teach that the TBC is YSZ having a yttria content of from about 3% by weight to about 5% by weight of the YSZ. However, Beele does teach that the oxide layer "2" (i.e., the TBC) should be made of a columnar grained oxide ceramic such as partially stabilized zirconia and can be deposited by PVD (Col.6, lines 19 – 24, and Col.7, lines 16 – 20). Bruce et al. teaches a TBC system to be utilized as a protective coating on gas turbine engine components (Abstract). The ceramic TBC layer is formed of YSZ having a columnar grain structure, the YSZ preferably containing about 2 to 5% by weight of yttria (Abstract). Importantly, Bruce et al. also teaches that, by using YSZ having a yttria content of less than 6% by weight, specifically about 2 to 5% by weight, the TBC system exhibits superior spallation resistance and adhesion when compared to conventional YSZ TBCs, such as 7%YSZ (Col.1, lines 5 – 11 and 63 – 66, Col.2, lines 39 – 50, Col.3, lines 37 – 50, and Col.4, lines 1 – 33 and 46 – 53). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a YSZ TBC having a yttria content of about 2 to 5% by weight (i.e., a weight percent within the applicant's claimed range), as taught by Bruce et al., as the "partially stabilized zirconia" layer "2" in the process of Beele with the reasonable expectation of successfully and advantageously producing a TBC that exhibits superior adhesion and spallation resistance, thereby increasing the life of the coating / component. This combination of references in no way renders the prior art unsatisfactory for its intended purpose, as alleged by the applicant, and is not an impermissible hindsight

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reconstruction, as also alleged by the applicant. The motivation to combine the references is clearly present in the prior art (see the discussion above), not the instant application.

40. Regarding the double patenting rejections, the applicant broadly argues that there is no objective basis for combining the teachings of the pairs of references in each case. This argument is not convincing because there is an objective basis for combining the references in the manner done so by the examiner, and this basis is and has been clearly set forth (see paragraphs 29 and 31 above).

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office Action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (571) 272-1422. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



WDM

Wesley D Markham
Examiner
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